

# A COMPARATIVE STUDY ON THE POTENTIAL OF *ASPERGILLUS NIGER* AND *ASPERGILLUS FLAVUS* FOR THE TREATMENT OF COFFEE PROCESSING EFFLUENT

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## ABSTRACT

An investigation was carried out to isolate the native fungi *Aspergillus niger* and *Aspergillus flavus*, which were tested for their individual bioremediation efficiency. The results showed that the initial concentration of the physico-chemical parameters such as total dissolved solids, biological oxygen demand and chemical oxygen demand was found to be very high which was drastically reduced upon inoculation of fungi. *A. niger* was found to be highly successful in reducing of TDS, BOD and COD with a percentage range of 82-89%, 86-92%, 77-84%, respectively whereas *A. flavus* showed reduction of 78-85%, 82-89%, 74-79%, respectively at different concentrations. The outcome of the present study indicates that these fungal strains have proved their bioremediation potency in the treatment of coffee processing effluent.

**KEYWORDS:** *Aspergillus Niger*, *Aspergillus Flavus*, Coffee Processing Effluent & Physico- Chemical Parameters

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## INTRODUCTION

Environmental pollution because of improper waste management is an alarming challenge for the developing countries to meet the developmental goals (Tekle *et al.*, 2015). The introduction of polluted effluent in the water bodies minimises self-cleansing capacity of water and thus results in the accumulation of pollutants to problematic or even harmful levels (Jaya and Vijayan 2016). Coffee processing units are one of the significant consumers of water. The traditional practice is to simply discharge the wastewater into a nearby stream or river. Resultant waste water is acidic, containing high concentration of organic matter, nutrients and suspended matter which leads to a very high pollution load affecting water quality (Novita, 2016 and Samanvitha *et al.*, 2013). The problem of water pollution level near the coffee processing plant is high (Daivasikamani *et al.*, 2014), which creates the need for the treatment of coffee effluent. Microbial biodegradation of organic compounds in wastewater is a key process in both natural and engineered systems (Tekle *et al.*, 2015). Biological treatment methods are of particular interest since microorganism offers efficiently reduce pollutants. In the present investigation *Aspergillus niger* and *Aspergillus flavus* were used for the treatment of coffee effluent for their capacity to reduce the effluent parameters.

## MATERIALS AND METHODS

### Effluent Source

The sample for the analysis was collected from a coffee processing unit in Chikmagalur District of Karnataka, India and stored at 4°C in the laboratory.

### Isolation and Identification of Microorganisms

The sample was serially diluted using sterile pipettes from  $10^{-1}$  to  $10^{-8}$  dilution (Sharma and Gupta, 2012). Using Lactophenol cotton blue staining technique fungal culture was identified as *Aspergillus niger* and *Aspergillus flavus* based on their morphology and reproductive structural characteristics (Nagamani et al., 2006). Isolated pure cultures were maintained in PDA media and stored at 4°C.

### Analysis of Physicochemical Parameters

Standard methods (APHA, 2009) were used for analyses of physico-chemical parameters like total dissolved solids, BOD and COD.

### Experimental Design

The effluent samples were diluted for three different concentrations via 25%, 50%, 75% and raw effluent is designated as a 100 % concentration and filtered through Whatman No 1 filter paper (Dhanushree and Kousar, 2017). The fungal isolates were inoculated into the effluent in conical flask which is supplemented with 0.5% concentration of glucose to improve the degradation efficiency of the microorganisms (Jaya *et al.*, 2016). The treatment conducted for a period of seven days. TDS, BOD and COD were analysed before and after treatment.

### Data Analysis

Results are expressed as mean $\pm$ SD (Table 1 and 2). Statistical analysis was performed using ez ANOVA 0.98 version applying one-way ANOVA followed by *Tukey's t-test*. The values are considered as statistically significant if  $p < 0.05$  or  $p < 0.01$ . The graphs and findings of the study were discussed and compared with available literatures.

## RESULTS AND DISCUSSIONS

The results of the physico-chemical analysis after treatment is enumerated in Table 1 and 2, which is statistically significant. Total dissolved solids (mg/L) in control was  $5499.16 \pm 0.16$ , whereas coffee effluent treated using *Aspergillus niger* has reduced to  $1002.5 \pm 0.26$  in raw effluent,  $895.3 \pm 0.17$  in 75% concentration,  $691.43 \pm 0.29$  in 50% concentration and  $302.3 \pm 0.29$  in 25% concentration (Table.1). Total dissolved solids (mg/L) in control was  $2710.4 \pm 0.45$ , in the presence of the *Aspergillus flavus*, it was observed that total dissolved solids was reduced gradually by  $687.23 \pm 0.25$ , in raw effluent,  $540.23 \pm 0.32$  in 75% concentration,  $390.5 \pm 0.45$  in 50% concentration and  $333.33 \pm 0.3$  in 25% concentration.

BOD in control was  $6611.33 \pm 1.33$ , BOD in the effluent treated with *Aspergillus niger* was reduced to  $200.3 \pm 0.17$  in the raw effluent,  $150.46 \pm 0.14$  in 75% concentration,  $120.7 \pm 0.25$  in 50% concentration, and  $60.46 \pm 0.29$  in 25% concentration which was appreciable during the treatment. BOD (mg/L) in control was  $3748.26 \pm 0.2$ , in the presence of the *Aspergillus flavus* it was observed that BOD was reduced gradually by  $790.17 \pm 0.2$ , in the raw effluent,  $630.08 \pm 0.1$  in 75% concentration,  $339.31 \pm 0.35$  in 50% concentration and  $150.44 \pm 0.5$  in 25% concentration. From the Figure 2, it is observed that for each concentration, percentage of BOD removal has increased with increase in dilution of the effluent,

which indicates that microorganisms function efficiently with increasing dilution.

COD (mg/L) in control was  $10389.51 \pm 0.93$ , COD in the effluent treated with *Aspergillus niger* was reduced by  $632.73 \pm 0.43$ , in raw effluent,  $433.83 \pm 0.26$  in 75% concentration,  $289.26 \pm 0.17$  in 50% concentration and  $203.06 \pm 0.56$  in 25% concentration. COD (mg/L) in control was  $5824.23 \pm 0.25$ , in the presence of the *Aspergillus flavus* it was observed that COD was reduced gradually by  $1680.08 \pm 0.1$ , in raw effluent,  $1394.31 \pm 0.35$  in 75% concentration,  $970.22 \pm 0.25$  in 50% concentration and  $590.043 \pm 0.05$  in 25% concentration. Concentration of COD has reduced significantly in increasing dilution, due to biological degradation and fermentation. (Figure.3). Concentration of COD has reduced significantly in increasing dilution, due to biological degradation and fermentation.

It is evident from the results that optimum reading of all the listed parameters was found to be in 25% concentration, compared to other concentrations. This trend was irrespective of the test isolate used for the treatment.

The present investigation relies on treatment of coffee processing effluent using two fungal species. Fungi are indicated to be highly effective in industrial fermentation and bioremediation (Akpor *et al.*, 2014). *Aspergillus niger* has shown better performance in all the tested parameters with greater reduction in all the concentrations compared to *Aspergillus flavus*. These findings are in agreement with Kowsalya *et al.*, (2010) and Soleimaninanadegani and Manshad (2014) who obtained a similar result while working on the same organisms.

**Table 1: Concentration of Parameters after Treatment with *Aspergillus niger***

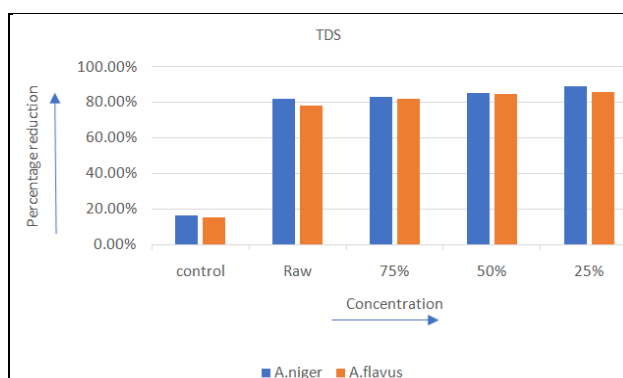
Parameters	Control	Raw	75% Concentration	50% Concentration	25% Concentration
TDS(mg/L)	$5499.16 \pm 0.16$	$1002.5 \pm 0.26^{**}$	$895.3 \pm 0.17^{**}$	$691.43 \pm 0.29^{**}$	$302.3 \pm 0.29^{**}$
BOD (mg/L)	$6611.33 \pm 1.33$	$200.3 \pm 0.17^{**}$	$150.46 \pm 0.14^{**}$	$120.7 \pm 0.25^{**}$	$60.46 \pm 0.29^{**}$
COD (mg/L)	$10389.51 \pm 0.93$	$632.73 \pm 0.43^{**}$	$433.83 \pm 0.26^{**}$	$289.26 \pm 0.17^{**}$	$203.06 \pm 0.56^{**}$

**Key:** (mg/L) = milligram per litre. Values are expressed as mean  $\pm$  SD (n=3), \*p<0.05; \*\*p<0.01, denotes significance with respect to control, using one-way ANOVA followed by Tukey's test.

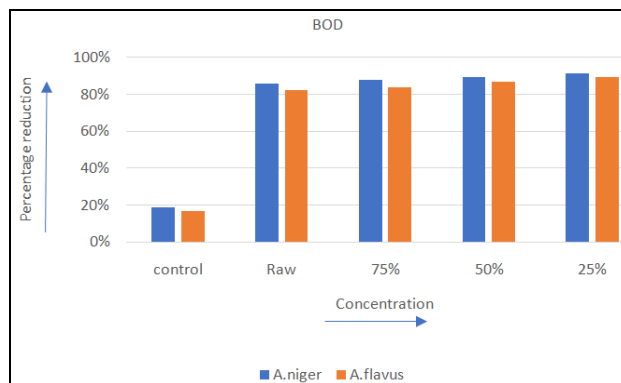
**Table 2: Concentration of Parameters after Treatment with *Aspergillus flavus***

Parameters	Control	Raw	75% Concentration	50% Concentration	25% Concentration
TDS (mg/L)	$2710.4 \pm 0.45$	$687.23 \pm 0.25^{**}$	$540.23 \pm 0.32^{**}$	$390.5 \pm 0.45^{**}$	$333.33 \pm 0.3^{**}$
BOD (mg/L)	$3748.26 \pm 0.2$	$790.17 \pm 0.2^{**}$	$630.08 \pm 0.1^{**}$	$339.31 \pm 0.35^{**}$	$150.44 \pm 0.5^{**}$
COD (mg/L)	$5824.23 \pm 0.25$	$1680.08 \pm 0.1^{**}$	$1394.31 \pm 0.35^{**}$	$970.22 \pm 0.25^{**}$	$590.043 \pm 0.05^{**}$

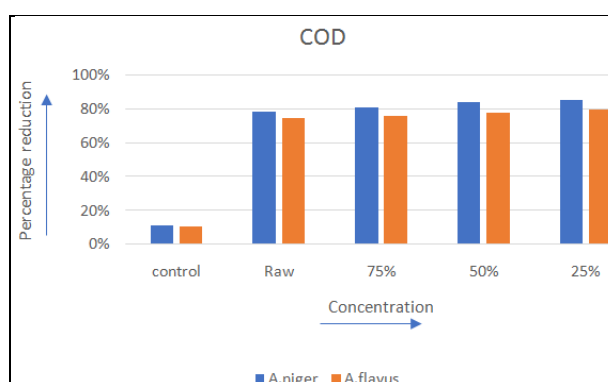
**Key:** (mg/L) = milligram per litre. Values are expressed as mean  $\pm$  SD (n=3), \*p<0.05; \*\*p<0.01, denotes significance with respect to control, using one-way ANOVA followed by Tukey's test.



**Figure 1: Percentage Reduction of TDS at Different Concentrations with Respect to *Aspergillus Niger* and *Aspergillus flavus***



**Figure 2: Percentage Reduction of BOD at Different Concentrations with respect to *Aspergillus niger* and *Aspergillus flavus***



**Figure 3: Percentage Reduction of COD at Different Concentrations with Respect to *Aspergillus niger* and *Aspergillus flavus***

## CONCLUSIONS

In the present study, the feasibility of isolated microorganisms for effective biodegradation of coffee processing effluent has been investigated. Both *Aspergillus niger* and *Aspergillus flavus* have shown potential in degradation of TDS, BOD and COD and maximum reduction were observed in 25% concentration. *Aspergillus niger* performed better than *Aspergillus flavus*. Indicating that the fungus could be applicable in the treatment of coffee effluent.

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